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# Progressive delivery of interactive content

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## **Progressive delivery of interactive content**

### **ABSTRACT**

Interactive elements in online content often lead to substantially increased total payload size to be delivered to a client device, e.g., to render a page. Delivering such content may introduce latency, thus degrading user experience. The techniques of this disclosure address this issue by delivering a compressed static image that mimics the visual feel of interactive elements of content. The image can be delivered faster because its size is significantly smaller than that of the interactive content. Subsequently, the image is replaced with the corresponding interactive content. With user consent, the replacement of the image with the corresponding content may be based on user interaction with a page on which the content is placed.

### **KEYWORDS**

- Progressive delivery
- Interactive content
- Latency reduction
- Low bandwidth
- Static image

### **BACKGROUND**

Online content is often rich in interactive User Interface (UI) components, such as carousels, expanding drawers, gallery views, etc. The code, images, other media, and text required to render and instantiate such online content can often be large in terms of the total size of delivered data. As a result, delivering the content from the server to a user device can introduce latency greater than what the user might deem acceptable, providing a degraded User eXperience (UX).

This issue is especially problematic in usage scenarios with constraints on bandwidth, such as the user device being in areas of low signal strength or using technology incapable of supporting high incoming data rates. The issue also surfaces in situations that involve limits on data usage, such as the caps set for mobile device data plans. Upon reaching the limit, the user is either downgraded to a lower bandwidth connection or is required to pay for additional data usage. Delivering large sized interactive content may result in latency in the former case and increased bills in the latter case.

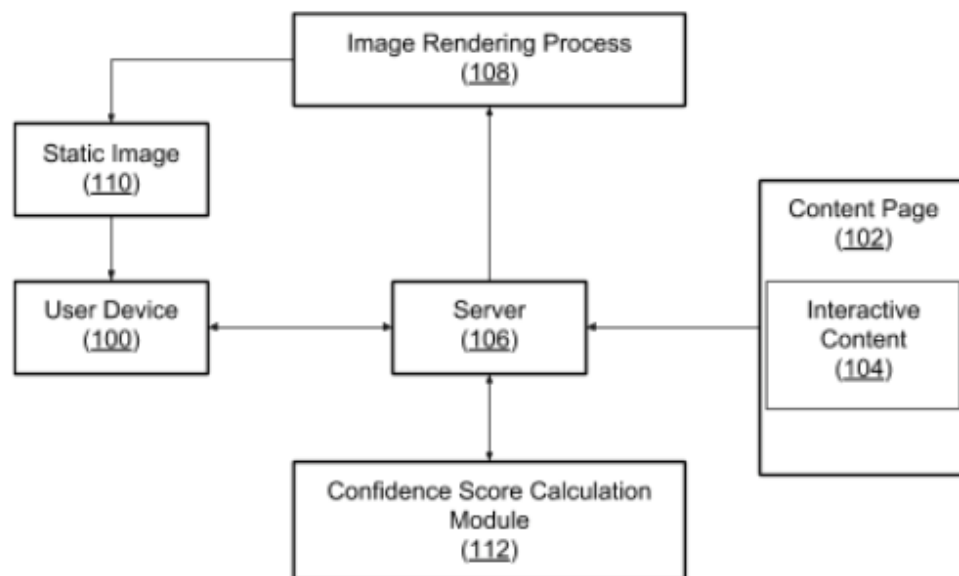
### DESCRIPTION

To address the issue of high latency in delivering interactive content that includes multiple interactive elements that have a substantial total size in bytes, the techniques of this disclosure deliver a compressed static image that mimics the visual appearance of interactive elements. The static image is generated by a server based on constructing the look and feel of the interactive content requested by the user. Such content includes interactive components such as carousels, expanding drawers, gallery views, etc. The image can be delivered faster since its size is substantially smaller than that of the interactive content. After the smaller sized image is delivered and finishes rendering on the user side, it is automatically replaced with the corresponding larger sized dynamic content after the component is delivered and is ready to be loaded and rendered.

A page, e.g., an interactive webpage, may contain multiple pieces of interactive content that may be processed and delivered as separate static images. In such cases, a variation of the technique involves replacing static images on a page only when the user is deemed likely to interact with the corresponding dynamic interactive components, thus reducing data usage and further reducing latency. Such operation is achieved by delaying delivery of the dynamic

interactive content corresponding to a static image until a confidence score that indicates the likelihood of the user interacting with the content crosses a threshold value.

The confidence score may be based on the position of the content on the page. For instance, content that is placed higher on a page is assigned higher confidence scores than content placed lower on the page that the user cannot see before scrolling. With user consent, the confidence score may additionally be based on user interaction with the page, such as scrolling or interacting with page elements. For instance, scrolling may result in adjustments to the confidence score based on the position of the content in relation to the current viewport. User interaction with an element of interactive content on the page may indicate higher likelihood of the user interacting with similar other content on the page. Therefore, the confidence scores for content elements similar to those that the user interacts with are adjusted upwards.



**Fig. 1: Interactive content delivered as a static image and subsequently replaced with corresponding content**

Fig. 1 illustrates the operation of the techniques of this disclosure. A user wishes to view a page (102) of interactive content (104) via a user device (100). The page is requested by the

user device from a server (106) that hosts the content. Upon receiving the request, an image rendering process (108) is invoked to generate the look and feel of the interactive content and render it as a static image (110). The static image is then delivered to the user device followed subsequently by delivery of the originally requested interactive content. The static image is displayed on the user device as soon as it is received. Subsequently, the image is replaced by the corresponding interactive content once it has finished transferring and is ready to be loaded and rendered for user interaction on the user device.

When the page is composed of multiple pieces of interactive content with corresponding static images, a confidence score calculation module (112) is invoked for each delivered static image. The confidence score calculation model computes and returns a confidence score for each image that indicates the likelihood of the user interacting with the dynamic interactive content corresponding to that image. As described earlier, the confidence score computation may be based on position of the content on the page or, with user consent, user interaction with the page and its content elements.

When the confidence score for a static image is higher than a threshold, the dynamic interactive content corresponding to that image is delivered by the server to the user device. Upon user consent, indicators of user interaction with the content page, such as scrolling, clicking, etc., may be utilized to calculate the confidence score. Interaction events are provided to the confidence score calculation module that accordingly adjusts and returns the confidence scores for each static image for which the corresponding dynamic content is yet to be delivered to the user device. The interactive content corresponding to any images for which the adjustments result in a confidence score higher than the threshold is then delivered to the user device. The threshold may be specified by the user, configured by the user device, set at the

server, or determined dynamically based on computational analyses of the page content and user interaction with the content.

In addition to conventional content pages and screens, the techniques of this disclosure can be effectively applied in situations that involve delivering content feeds with UI techniques such as infinite scrolling. The techniques can handle pages that change, grow, or alter the UI after some initial content has loaded. The techniques are also applicable to pages with a ranked list of content elements, such as search engine result pages.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user's social network, social actions or activities, profession, a user's preferences, or a user's current location), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

## CONCLUSION

To address the issue of high latency in delivering interactive content that includes multiple interactive elements that have a substantial total size in bytes, the techniques of this disclosure deliver a compressed static image that mimics the visual appearance of interactive elements. The image can be delivered faster because its size is significantly smaller than that of

the interactive content. Subsequently, the image is replaced with the corresponding interactive content. With user consent, the replacement of the image with the corresponding content may be based on user interaction with the page on which the content is placed. In addition to conventional content pages and screens, the techniques of this disclosure may be effectively applied for content feeds, search engine results pages, and pages that change, grow, or alter the UI after the initial content has loaded.